UNIVERSITI PUTRA MALAYSIA

REVIEW ON SYSTEMATIC OF CALANOID COPEPOD (CRUSTACEA) FROM SEAGRASS AND CORAL AREAS OF THE EAST COAST OF THE MALAY PENINSULA

MOHD AFANDY BIN BABA @ ABDUL KADIR

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By

MOHD AFANDY BIN BABA @ ABDUL KADIR

Thesis submitted to the School of Graduates Studies, Universiti Putra Malaysia, in Fulfillment of The Requirements for the Degree of Master of Science

April 2002

DEDICATION

MY PARENT (& IN-LAW)
ABAH, MAK AND MEK

MY BELOVED WIFE,
ZAHARAH CHE MAHMOOD.

MY LITTLE LOVELY SONS AND DAUGHTER,
MUHAMMAD NASYRUL ADLY
MUHAMMAD AIMAN SYAHMY
NURUL IFFAH
IMRAN NUR HAKIM

MY SISTERS AND BROTHERS (& IN-LAWS)
ALL MY TEACHERS,
OR THOSE WHO GIVE ME KNOWLEDGES,
ALL MY FRIENDS
Thank you for all your prayers and endless support

JAZAKUMULLAHU KHAIRAN KATHIIRA

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirements for the degree of Master of Science.

REVIEW ON SYSTEMATIC OF CALANOID COPEPOD (CRUSTACEA) FROM SEAGRASS AND CORAL AREAS OF THE EAST COAST OF MALAY PENINSULA

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MOHD AFANDY BIN BABA @ ABDUL KADIR

April 2002

Chairman : Drs. Idris Abdul Ghani

Faculty : Science and Environmental Studies

A study has been carried out on the systematic of calanoid copepod from samples taken off sea grass and coral area in East Coast of Peninsular Malaysia. The material examined was taken from various samples collected since 1990 until 1997 in Pulau Sibu, Pulau Besar, Pulau Redang and Pulau Bidong. Thirty-four species representing 16 genera and 12 families were described and illustrated. Six species are new record for Malaysian coastal water. They are *Subeucalanus crassus, S. subcrassus, S. pileatus, Labidocera kroeyeri, Centropages yamadai* and *Bestiolina similis*. *Subeucalanus* is a new record for genus. This study also found that the species *Centropages yamadai* is also new to Indo Pacific region.

This study also reviewed the systematic and distribution of calanoid copepod in Malaysian waters based on published and unpublished literatures. Misidentification and misuse of species names in the literature have been corrected where possible.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KAJIAN SEMULA KE ATAS SISTEMATIK BAGI KOPEPOD CALANOID (CRUSTACEA) DI KAWASAN RUMPUT LAUT DAN TERUMBU KARANG PANTAI TIMUR SEMENANJUNG MALAYSIA.

Oleh

MOHD AFANDY BIN BABA @ ABDUL KADIR

April 2002

Pengerusi : Drs. Idris Abdul Ghani

Fakulti : Sains dan Pengajian Alam Sekitar

Sistematik calanoid kopepod di ekosistem rumput laut dan batu karang di perairan pantai timur Semenanjung Malaysia telah diteliti. Sampel kajian adalah hasil pengumpulan beberapa siri penyampelan yang dilakukan dari tahun 1990 hingga 1997 di Pulau Sibu, Pulau Besar, Pulau Redang dan Pulau Bidong. Sebanyak tiga puluh empat spesis mewakili 16 genera dan 12 famili yang telah dikenalpasti dan dilukis. Enam spesis merupakan rekod baru bagi perairan Malaysia. Spesis tersebut ialah *Subeucalanus crassus, S. subcrassus, S. pileatus, Labidocera kroeyeri, Centropages yamadai* dan *Bestiolina similis*. Kajian ini juga mendapati spesis *Centropages yamadai* adalah rekod baru kepada perairan Indo-Pacific.

Kajian ini juga mengulas kembali tentang sistematik and taburan kopepod calanoid di perairan Malaysia berdasarkan bahan yang telah diterbitkan atau tidak diterbitkan. Ketidaktepatan pengecaman dan kesilapan pada nama spesis telah dibetulkan sekiranya perlu.

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I certify that an examination Committee met on 19th April 2002 to conduct the final examination of Mohd Afandy bin Baba @ Abdul Kadir on his Master of Science thesis entitled "Review on Systematic of Calanoid Copepod (Crustacea) from Seagrass and Coral Areas of the East Coast of the Malay Peninsula" in accordance Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The committee recommends that candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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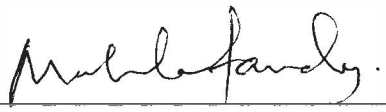
DECLARATION

I hereby declare that this thesis is based on my original work except for quotations and citations that have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.



Candidate:
MOHD AFANDY BIN BABA @ ABDUL KADIR

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A1	- Antenule/first antenna
A2	- Antenna
CR	- caudal rami
Th	- thoracic segment.
Th1, Th2, ..	- thoracic segment 1, thoracic segment 2, ….
Ab	- Abdomen
Uro	- urosome
Uro1, Uro2…	- urosome segment 1, segment 2…..
Mdb	- mandibula
M	- maxilla
M1	- maxillule
H'	- diversity index
s.d.	- standard deviation

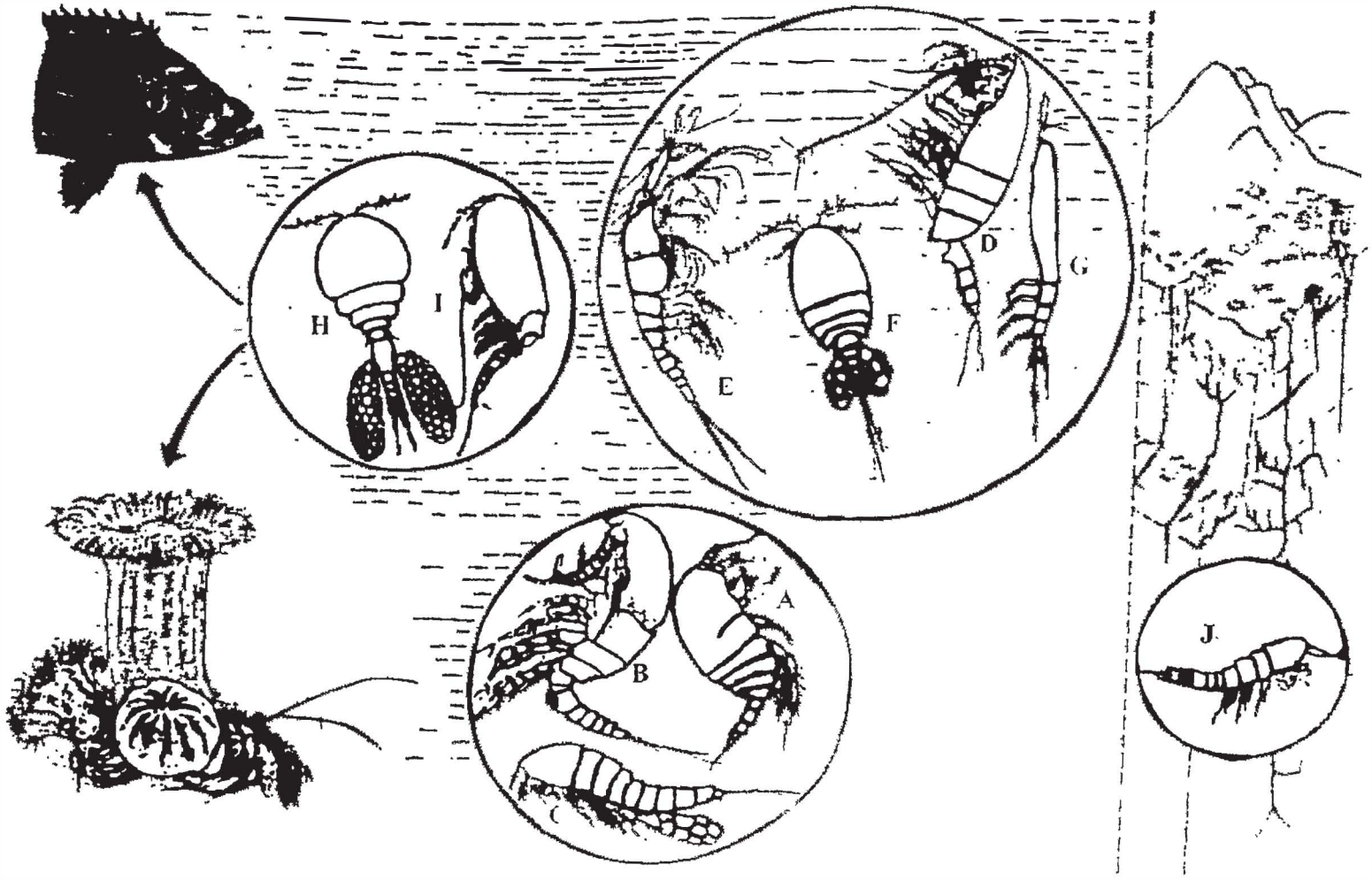
CHAPTER 1

INTRODUCTION

The Malay Peninsula surrounded by the Malacca Straits in the west coast and South China Sea in the east coast, which are highly abundant with unexplored fauna, that part of the complex planktonic life forms. The taxonomical study of marine copepods had been developed since early of the 18th decade. In Malaysia study of those copepod fauna has not been well updated. The taxonomy of calanoid copepod in Malaysia has to be revised prior to other aspects of study. This study is focused on the calanoid copepods, the most dominant fauna of planktonic crustacean.

Calanoida is the biggest among ten order of the subclass Copepoda, Class Crustacea, phylum Arthropoda. They are also being the most diverse group of in term of species especially in marine, which composed over a thousand species of all over the world (Sorokin, 1993). They occupied several types of marine habitats as showed in the schematic representation of the primary habitat of each of the ten copepod orders as in Figure 1.1.

Some species of calanoid may serve as food for livestock and domestic fowls. *Calanus finmarchicus* and *Calanus plumchrus* are the most dominant species of calanoid copepod in the North Atlantic and North Pacific Ocean respectively. They are caught and utilized directly as crustacean paste for fish consumption in aquaculture. At the same time, *Calanus plumchrus* has been utilized directly for many years in Hokkaido, Japan. These marine planktonic copepods are of high nutrient value. For example calculated as dried weight, Calanus contains 10 to 40%



1.2 Figure 1.1: Copepod habitats: representation of the primary habitat of each of the ten order of copepod. A. Platycopioida. B. Misophrioida. C. Harpacticoida. D. Calanoida. E. Mormonilloida. F. Cyclopoida. G. Monstrilloida. H. Poecilostomatoida. I. Siphonostomatoida. J. Gelvelloida. [A-C, benthic; D-G, planktonic; H and I, associated; J, groundwater](Huys and Boxshall, 1991)

protein, 12 to - 47% lipid, 3% chitin and 3.6% ash. In the protein about 20 kinds of important amino acids are found (Zheng, 1989). Consequently, copepods used as food for livestock are of high economic significance.

A large number of adult fish, particularly tropical reef fish, make evasive prey such as calanoids an important part of their diet (Emery, 1973; Hobson, 1974; Hobson & Chess 1976 (in Milton *et al*., 1990)). These reef zooplanktivores, sometimes termed water column foragers (Davies & Birdsong, 1973 (in Sorokin, 1993) of plankton pickers (Collete & Talbot, 1972) are diurnal opportunistic zooplanktivores which feed on the plankton found near coral reefs, often forming dense, multispecies aggregations of fish.

Most evidence of reef fish feeding on calanoids comes from gut content analysis of wild caught fish (e,g. Emery, 1973; Hobson & Chess, 1976 (in Milton et al., 1990)). While this type of data describes the principal components of diet of zooplanktivorous fish, it does not address an equally important question; by what mechanism can some zooplanktivores feed regularly on highly evasive prey such as calanoid copepods?

1.1 Importance of Study

The study of copepod had been started since the early of 18th decade but the information on copepods from Malaysian waters still rare. It has to be established and upgraded prior to any developments in all types the coastal areas due to rapid developments towards the year 2020. Subsequently, datas of copepods from coral

reef and seagrass ecosystems around Malaysian water are need to investigate. It is essential and prior for scientific research and also to wider the knowledge on the zooplankton in Malaysia waters.

Pertinent literature of the systematic of calanoid copepods of Malaysian coastal waters is not been done extensively. Previously, species of copepods from Malaysian waters have been recorded in some general studies on the distribution and ecology. Started with pioneer study by Sewell in 1933, it is then followed by Wickstead (1961); Seng, (1984); Sarepah (1987); Idris *et al*., (1993); Zalina, (1993) and Idris *et al*., (1997a,1997b, 1999). All those studies were mostly discussed on the distribution of calanoid copepods as a major part of marine zooplankton.

Studies on the taxonomy of Malaysian pelagic copepods are extremely rare. The only studies have been carried out by Arvin (1977); Zuraini (1986); Othman (1986, 1987) and Zaleha, (1996). The knowledge of this fauna (copepods) in Malaysian marine water region should be started with a detail study on their taxonomical description. Taxonomical studies should be the first consideration on any studies of living fauna.

More studies are needed to determine the species composition, life cycles, feeding habit, diurnal movements, lunar cycles and seasonal cycles of this unique group of plankton (Porter & Porter 1977). Obviously, many more reefs will have to be sampled before zoogeographical trends can be seen. Most 'reefs' plankton studies to date have not directly addresses to this group. According to Sorokin (1993), it must however, be emphasised that an accurate specific diagnosis is a matter for a specialist and will usually involve micro-dissection and examination of the appendages.

According to Wolfgang (1986), species differences are often minute and superficial examination without careful study of original literature only allows gross identification.

The objectives of this study are as follows:-

1. To update the record of calanoid copepod biodiversity in Malaysian coastal water especially at sea grass and coral area.
2. To establish the taxonomical characteristic descriptions and illustrations calanoid copepods in coral reefs and sea grass ecosystems within Malaysian marine waters.
3. To review the systematic and distribution of calanoid copepods in Malaysian waters.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction to the Calanoid Copepod.

As the most diverse group amongst copepod, the order of Calanoida is also known as a dominant zooplankton and constitutes of a considerable part of the secondary production. They are abundant in fresh water and inland saline habitats in British waters or, for that matter in most other sea areas (Newell & Newell, 1977).

Most of Calanoid copepods are generally to be pelagic, living in the water column away from the influence of the seabed. Some live in the near-bottom community and a few are more or less benthic (Huys & Boxshall, 1991), which known as hypermetric or demersal Calanoid (Ohtsuka, 1992). They occur at all depths in the water column, from surface to the abyssal trenches.

Zooplankton is a very important biota in the ocean not only do they serve as primarily uses; they are also food for economic fishes. Zooplankton is also sensitive to any environmental changes thus it can be a good indicator to access the changes in marine ecosystem.

The environment and plankton community together forms comprehensive ecosystem as in any aquatic ecosystem. These interactions give rise to many adaptations by the organism to a planktonic existence (Wickstead, 1976)

In general copepods are the major members of the marine zooplankton community, constituting the food item of fishes. Hence, copepod occupies an important position in the food web and energy flows of the marine ecosystem environments.

Many crustaceans are phytoplankton feeder and pelagic economic fishes and whales then feed them upon. Hence, planktonic crustaceans play an important role in the food cycle of the sea. Copepoda, Ostracoda and Malacostraca are three of the important subclasses of this phylum (Zheng, 1989). Among the important group in subclass copepoda are the order calanoid and cyclopoid and others.

On looking at the potential at the copepod being a replacement to *Artemia*, the fish Fisheries Department of Malaysia is conducting research of monoculture of copepod in big tanks and brackish ponds (Azhar, 1998). This copepod will then supplied to the hatcheries. Copepod such as *Acartia*, *Paracalanus*, *Pseudodiaptomus* and *Oithona* are good prey for fish larvae.

2.1 Seagrass and Coral Reef Habitat

The Indo-West Pacific Basin is concentrated the greatest number of species of marine life (Ekman, 1991). Being a part of the faunistic region of the Indo-West Pacific, Malaysia blessed with a rich marine environment and ecosystems such as coral reefs, sea grasses, seaweeds, mangroves and various kinds of beaches. They are known to associate with various kinds of fauna especially in the aquatic environment. One of them is the zooplankton, which occurred, in a bulk number in term of species as well as the individuals.

Sea grass and coral reefs are known for the diversity and abundance of their fish and invertebrate faunas. Sea grass beds are recognized as important nursery ground for many important commercials and forage organisms as well as some of the reef species. About 12% of the total fish catches in the world are proceed by coral reefs and sea grass ecosystem (Fortes, 1990). These ecosystems provide food and shelter to avoid strong current, predator and sunlight to various of marine faunas.

Sea grass inhabitants of tropical and temperate waters, form important part of coastal ecosystems. They are the main food of the dugong (sea cow), turtle and other marine animals and provide necessary surface for attachment, growth and development of many epiphytic seaweeds and small organism which in turn important food for many marine animals. Thus, sea grass as the "back bone" of complex marine communities but their role has often overlooked due to the submerged state.

Sea grass beds have long been viewed as unique and important coastal ecosystems. Much of the justification for the perceived importance of sea grass beds lies with its function as a nurturing habitat for fauna. Dense shelter in the form of sea grass canopy and food chains fueled by high in situ primary production, are held to provide the basis for very high faunal productivity (Larkum *et al.*,1992).

In Peninsular Malaysia most of the sites of sea grass and coral ecosystem are situated in the East Coast. Sea grass areas are well distributed around Pulau Sibu and Pulau Besar, Mersing. There are three dominant species; that is *Enhalus acoroides*,

Cymodocea serrulata and *Halodule uninervis* (Rajudin, 1992). Other known site is in Besut, Terengganu and rarely occurred in Port Dickson.

Malaysia has been known among the most beautiful sites of coral reef. These ecosystems are located mostly in small island of the east coast, Sabah and Sarawak. In the west coast it can be found around Malacca Straits at Pulau Besar, Pulau Payar and Pulau Sembilan. Scuba diving, snorkeling and touring is the main activities in Pulau Redang, Pulau Tioman, Pulau Kapas and others due to the occurrence of their beautiful corals. Several areas such as Pulau Redang, Pulau Sibu, Pulau Besar, and Pulau Payar have been gazette as a Fisheries Protected Area and subsequently as a marine park. It is to provide the unique sea grass and coral reefs ecosystem unexploited marine gardens.

Most of popular tourist islands are found in east coast region and visits to these islands are usually made during the dry non-monsoonal months from March to October. The main Islands are Pulau Perhentian, Pulau Redang, Pulau Kapas, Pulau Aur, Pulau Pemanggil, and Pulau Tioman

2.2 Classification of Calanoid Copepods

Sars first suggested the classification adopted for copepods order in 1900 to 1903 (cited in Zheng, 1989) who divided the Order Copepoda into seven suborders, Calanoida, Cyclopoida, Arguloida, Notodelphyoida, Monstrilloida and Cagilloida. Later a modified Sars's system of classification proposed by Gurney (1931-1933) is adopted, the raising of all the suborders to the rank of orders. To date, according to